

WHAT IS CLAIMED IS:

1. An electrostatic capacitance detection device for reading surface contours of an object by detecting an electrostatic capacitance, which changes according to a distance with the object, comprising:

M individual power supply lines and N individual output lines, arranged in a matrix of M rows  $\times$  N columns, and electrostatic capacitance detection elements provided on crossing points of the individual power supply lines and the individual output lines,

each of the electrostatic capacitance detection elements being formed of a signal detection element and a signal amplification element,

the signal detection element being formed of a capacitance detecting electrode, a capacitance detecting dielectric layer and a reference capacitor,

the reference capacitor being formed of a reference capacitor first electrode, a reference capacitor dielectric layer and a reference capacitor second electrode, and

the signal amplification element being formed of a MIS type thin film semiconductor device for signal amplification, including a gate electrode, a gate insulating layer and a semiconductor layer.

2. The electrostatic capacitance detection device according to claim 1, a drain region of the MIS type thin film semiconductor device for signal amplification being electrically coupled to the individual power supply lines and the reference capacitor first electrode, and a gate electrode of the MIS type thin film semiconductor device for signal amplification being coupled to the capacitance detecting electrode and the reference capacitor second electrode.

3. The electrostatic capacitance detection device according to claim 1, the reference capacitor dielectric layer and the gate insulating layer of the MIS type thin film semiconductor device for signal amplification being formed with a same material on a same layer.

4. The electrostatic capacitance detection device according to claim 1, the reference capacitor first electrode and a drain region of the semiconductor film being formed with a same material on a same layer.

5. The electrostatic capacitance detection device according to claim 1, the reference capacitor second electrode and the gate electrode being formed with a same material on a same layer.

6. The electrostatic capacitance detection device according to claim 1,

using an area of the reference capacitor electrode of  $S_R$  ( $\mu\text{m}^2$ ), a gate electrode area of the MIS type thin film semiconductor device for signal amplification of  $S_T$  ( $\mu\text{m}^2$ ), a thickness of the reference capacitor dielectric layer of  $t_R$  ( $\mu\text{m}$ ), a dielectric constant of the reference capacitor dielectric layer of  $\epsilon_R$ , a thickness of the gate insulating layer of  $t_{ox}$  ( $\mu\text{m}$ ), and a dielectric constant of the gate insulating layer of  $\epsilon_{ox}$ , a capacitance  $C_R$  (reference capacitor capacitance) of the reference capacitor and a transistor capacitance  $C_T$  of the MIS type thin film semiconductor device for signal amplification are defined as

$$C_R = \epsilon_0 \cdot \epsilon_R \cdot S_R / t_R,$$

$$C_T = \epsilon_0 \cdot \epsilon_{ox} \cdot S_T / t_{ox}$$

where  $\epsilon_0$  is permittivity in vacuum, respectively; and

using an area of the capacitance detecting electrode of  $S_D$  ( $\mu\text{m}^2$ ), a thickness of the capacitance detecting dielectric layer of  $t_D$  ( $\mu\text{m}$ ), and a dielectric constant of the capacitance detecting dielectric layer of  $\epsilon_D$ , an element capacitance  $C_D$  of the signal detection element is defined as

$$C_D = \epsilon_0 \cdot \epsilon_D \cdot S_D / t_D$$

where  $\epsilon_0$  is permittivity in vacuum, and

the element capacitance  $C_D$  being sufficiently larger than  $C_R + C_T$ , a summation of the capacitance  $C_R$  of the reference capacitor and the transistor capacitance  $C_T$ .

7. The electrostatic capacitance detection device according to claim 2, the capacitance detecting dielectric layer being located on an uppermost surface of the electrostatic capacitance detection device.

8. The electrostatic capacitance detection device according to claim 7, the object being apart from the capacitance detecting dielectric layer with an object distance of  $t_A$  without contacting, a capacitance  $C_A$  of the object being defined as

$$C_A = \epsilon_0 \cdot \epsilon_A \cdot S_D / t_A$$

using the permittivity in vacuum of  $\epsilon_0$ , a dielectric constant of air of  $\epsilon_A$ , and an area of the capacitance detecting electrode of  $S_D$ , and

$C_R + C_T$ , a summation of the capacitance  $C_R$  of the reference capacitor and the transistor capacitance  $C_T$ , being sufficiently larger than the capacitance  $C_A$  of the object.

9. The electrostatic capacitance detection device according to claim 1, using an area of the reference capacitor electrode of  $S_R$  ( $\mu\text{m}^2$ ), a gate electrode area of the MIS type thin film semiconductor device for signal amplification of  $S_T$  ( $\mu\text{m}^2$ ), a thickness of the reference capacitor dielectric layer of  $t_R$  ( $\mu\text{m}$ ), a dielectric constant of the

reference capacitor dielectric layer of  $\epsilon_R$ , a thickness of the gate insulating layer of  $t_{ox}$  ( $\mu m$ ), and a dielectric constant of the gate insulating layer of  $\epsilon_{ox}$ , a capacitance  $C_R$  of the reference capacitor and a transistor capacitance  $C_T$  of the MIS type thin film semiconductor device for signal amplification are defined as

$$C_R = \epsilon_0 \cdot \epsilon_R \cdot S_R / t_R,$$

$$C_T = \epsilon_0 \cdot \epsilon_{ox} \cdot S_T / t_{ox}$$

where  $\epsilon_0$  is the permittivity in vacuum, respectively; and

using an area of the capacitance detecting electrode of  $S_D$  ( $\mu m^2$ ), a thickness of the capacitance detecting dielectric layer of  $t_D$  ( $\mu m$ ), and a dielectric constant of the capacitance detecting dielectric layer of  $\epsilon_D$ , an element capacitance  $C_D$  of the signal detection element is defined as

$$C_D = \epsilon_0 \cdot \epsilon_D \cdot S_D / t_D$$

where  $\epsilon_0$  is the permittivity in vacuum; and

the element capacitance  $C_D$  being sufficiently larger than  $C_R + C_T$ , a summation of the capacitance  $C_R$  of the reference capacitor and the transistor capacitance  $C_T$ ; and

when the object is apart from the capacitance detecting dielectric layer with an object distance of  $t_A$  without contacting, the capacitance  $C_A$  of the object is defined as

$$C_A = \epsilon_0 \cdot \epsilon_A \cdot S_D / t_A$$

using the permittivity in vacuum of  $\epsilon_0$ , a dielectric constant of air of  $\epsilon_A$ , and an area of the capacitance detecting electrode  $S_D$ ; and

$C_R + C_T$ , a summation of the capacitance  $C_R$  the reference capacitor and the transistor capacitance  $C_T$ , being sufficiently larger than capacitance  $C_A$  of the object.

10. An electrostatic capacitance detection device for reading surface contours of an object by detecting an electrostatic capacitance, which changes according to the distance with the object, comprising:

M individual power supply lines and N individual output lines, arranged in a matrix of M rows  $\times$  N columns, and electrostatic capacitance detection elements provided on crossing points of the individual power supply lines and the individual output lines;

each of the electrostatic capacitance detection elements being formed of a signal detection element and a signal amplification element;

the signal detection element being formed of a capacitance detecting electrode, a capacitance detecting dielectric layer and a reference capacitor;

the reference capacitor being formed of a reference capacitor first electrode, a reference capacitor dielectric layer and a reference capacitor second electrode;

the signal amplification element being formed of a MIS type thin film semiconductor device for signal amplification, including a gate electrode, a gate insulating layer and a semiconductor layer; and

a part of a drain region and a part of a gate region of the MIS type thin film semiconductor device for signal amplification forming an overlapped portion via the gate insulating layer, and an overlapped portion forms the reference capacitor.

11. The electrostatic capacitance detection device according to claim 10, using a gate electrode length, which is an overlapped portion of the gate electrode of the MIS type thin film semiconductor device for signal amplification and the semiconductor layer drain region,  $L_1$  ( $\mu\text{m}$ ), a gate electrode length, which is an overlapped portion of the gate electrode of the MIS type thin film semiconductor device for signal amplification and the semiconductor layer channel forming region,  $L_2$  ( $\mu\text{m}$ ), a width of the gate electrode of  $W$  ( $\mu\text{m}$ ), a thickness of the gate insulating layer of  $t_{ox}$  ( $\mu\text{m}$ ), a dielectric constant of the gate insulating layer of  $\epsilon_{ox}$ , a capacitance  $C_R$  of the reference capacitor and a transistor capacitance  $C_T$  of the MIS type thin film semiconductor device for signal amplification are defined as

$$C_R = \epsilon_0 \cdot \epsilon_{ox} \cdot L_1 \cdot W / t_{ox},$$

$$C_T = \epsilon_0 \cdot \epsilon_{ox} \cdot L_2 \cdot W / t_{ox}$$

where  $\epsilon_0$  is the permittivity in vacuum, respectively; and

using an area of the capacitance detecting electrode of  $S_D$  ( $\mu\text{m}^2$ ), a thickness of the capacitance detecting dielectric layer of  $t_D$  ( $\mu\text{m}$ ), and a dielectric constant of the capacitance detecting dielectric layer of  $\epsilon_D$ , an element capacitance  $C_D$  of the signal detection element is defined as

$$C_D = \epsilon_0 \cdot \epsilon_D \cdot S_D / t_D$$

where  $\epsilon_0$  is the permittivity in vacuum; and

the element capacitance  $C_D$  being sufficiently larger than  $C_R + C_T$ , a summation of the capacitance  $C_R$  of the reference capacitor and the transistor capacitance  $C_T$ .

12. The electrostatic capacitance detection device according to claim 10, the object being apart from the capacitance detecting dielectric layer with an object distance of  $t_A$  without contacting, a capacitance  $C_A$  of the object is defined as

$$C_A = \epsilon_0 \cdot \epsilon_A \cdot S_D / t_A$$

using the permittivity in vacuum of  $\epsilon_0$ , a dielectric constant of air of  $\epsilon_A$ , and an area of capacitance detecting electrode of  $S_D$ ; and

$C_R+C_T$ , a summation of the capacitance  $C_R$  of the reference capacitor and the transistor capacitance  $C_T$ , is sufficiently larger than the capacitance  $C_A$  of the object.

13. The electrostatic capacitance detection device according to claim 10, the capacitance detecting dielectric layer being located on an uppermost surface of the electrostatic capacitance detection device, using a gate electrode length, which is an overlapped portion of the gate electrode of the MIS type thin film semiconductor device for signal amplification and the semiconductor layer drain region,  $L_1$  ( $\mu\text{m}$ ), a gate electrode length, which is an overlapped portion of the gate electrode of the MIS type thin film semiconductor device for signal amplification and the semiconductor layer channel forming region,  $L_2$  ( $\mu\text{m}$ ), a width of the gate electrode of  $W$  ( $\mu\text{m}$ ), a thickness of the gate insulating layer of  $t_{ox}$  ( $\mu\text{m}$ ), a dielectric constant of the gate insulating layer of  $\epsilon_{ox}$ , a capacitance  $C_R$  of the reference capacitor and a transistor capacitance  $C_T$  of the MIS type thin film semiconductor device for signal amplification are defined as

$$C_R = \epsilon_0 \cdot \epsilon_{ox} \cdot L_1 \cdot W / t_{ox},$$

$$C_T = \epsilon_0 \cdot \epsilon_{ox} \cdot L_2 \cdot W / t_{ox}$$

where  $\epsilon_0$  is the permittivity in vacuum, respectively; and

using an area of the capacitance detecting electrode of  $S_D$  ( $\mu\text{m}^2$ ), a thickness of the capacitance detecting dielectric layer of  $t_D$  ( $\mu\text{m}$ ), and a dielectric constant of the capacitance detecting dielectric layer of  $\epsilon_D$ , an element capacitance  $C_D$  of the signal detection element is defined as

$$C_D = \epsilon_0 \cdot \epsilon_D \cdot S / t_D$$

where  $\epsilon_0$  is the permittivity in vacuum; and

the element capacitance  $C_D$  being sufficiently larger than  $C_R+C_T$ , a summation of the capacitance  $C_R$  of the reference capacitor and the transistor capacitance  $C_T$ ; and

when the object is apart from the capacitance detecting dielectric layer with an object distance of  $t_A$  without contacting, a capacitance  $C_A$  of the object is defined as

$$C_A = \epsilon_0 \cdot \epsilon_A \cdot S_D / t_A$$

using the permittivity in vacuum of  $\epsilon_0$ , a dielectric constant of air of  $\epsilon_A$ , and an area of the capacitance detecting electrode of  $S_D$ ; and

$C_R+C_T$ , a summation of the capacitance  $C_R$  of the reference capacitor and the transistor capacitance  $C_T$ , being sufficiently larger than the capacitance  $C_A$  of the object.